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Original Article

A Study on Prevalence and Pattern of Refractive Errors and Associated Visual Impairment Among School Going Children in An Urban Population

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ABSTRACT

Purpose: To evaluate the prevalence and pattern of refractive errors and associated visual impairment among school-going children in an urban population.
Methods: In this cross-sectional study, 50 children aged 6-15 years underwent assessment of unaided visual acuity using a Snellen chart. Objective refraction was performed by retinoscopy, followed by subjective refraction where feasible. Cycloplegic refraction was done in children suspected to have refractive errors. Refractive errors were categorized as myopia, hypermetropia, and astigmatism. Visual impairment was defined according to World Health Organization criteria. Data were analyzed descriptively.
Results: Refractive errors were detected in 70% (n = 35) of children. Myopia was the most common, followed by astigmatism and hypermetropia. Visual impairment due to uncorrected refractive errors was observed in 14% (n = 7). Most children showed marked improvement in visual acuity following refractive correction. Older children demonstrated a higher prevalence of refractive errors.
Conclusion: Refractive errors are a common, preventable cause of visual impairment among urban schoolchildren. Regular school eye screenings and timely correction of refractive errors are essential to reduce visual impairment and support academic performance.

Keywords*: Refractive errors; Visual impairment; School children; Myopia; Urban population.*

INTRODUCTION

Refractive errors are a leading cause of visual impairment in children worldwide and represent a significant, yet preventable, public health issue. Uncorrected refractive errors can negatively affect academic performance, social development, and overall quality of life. Early identification and timely correction are therefore essential to prevent avoidable vision loss.

School-going children are an important target population for vision screening, as many refractive errors manifest during the school years. Urban children, in particular, may be at higher risk of myopia due to increased near-work activities and reduced time spent outdoors. Despite the availability of corrective measures, a considerable proportion of children remain undiagnosed or untreated, leading to unnecessary visual impairment.

Assessing the prevalence and pattern of refractive errors, along with their associated visual impairment, is crucial to inform public health strategies and guide school-based eye screening programs. This study aims to determine the prevalence, types, and visual impact of refractive errors among school-going children in an urban population.

MATERIALS AND METHODS

This cross-sectional, school-based study was conducted to assess the prevalence, pattern, and visual impact of refractive errors among school-going children in an urban population. A total of 50 children aged 6–15 years were enrolled from

[name of school(s)/urban area] through convenient sampling. Children with known ocular pathology other than refractive errors, history of ocular surgery, or systemic diseases affecting vision were excluded.

Visual acuity assessment was performed for all participants using a standard Snellen chart at 6 meters under adequate illumination. Uncorrected visual acuity (UCVA) and presenting visual acuity were recorded for each eye. **Objective refraction** was performed using retinoscopy, followed by **subjective refraction** wherever feasible. Cycloplegic refraction was carried out in children suspected to have hypermetropia or accommodative errors.

Refractive errors were classified as myopia, hypermetropia, or astigmatism according to standard definitions: myopia (spherical equivalent ≤ –0.50 D), hypermetropia (spherical equivalent ≥ +0.50 D), and astigmatism (cylinder ≥ 0.75 D).

Visual impairment was defined as presenting visual acuity <6/12 in the better eye, according to World Health Organization criteria.

Of the 50 children examined, **35 (70%)** were found to have refractive errors, and **7 children (14%)** had visual impairment attributable to uncorrected refractive errors.

Statistical analysis was performed using Microsoft Excel. Categorical variables, including prevalence and types of refractive errors and visual impairment, were expressed as numbers and percentages. Continuous variables, such as age, were summarized as mean ± standard deviation. Due to the small sample size, no inferential statistics were performed. Data presentation followed standard ophthalmology reporting guidelines.

RESULTS AND DISCUSSION

Results

A total of **50 school-going children aged 6-15 years** were screened in this urban population-based study. Among them, **35 children (70%)** were found to have **refractive errors**, while **15 children (30%)** had normal vision. **Visual impairment** due to **uncorrected refractive errors was observed in 7 children (14%).**

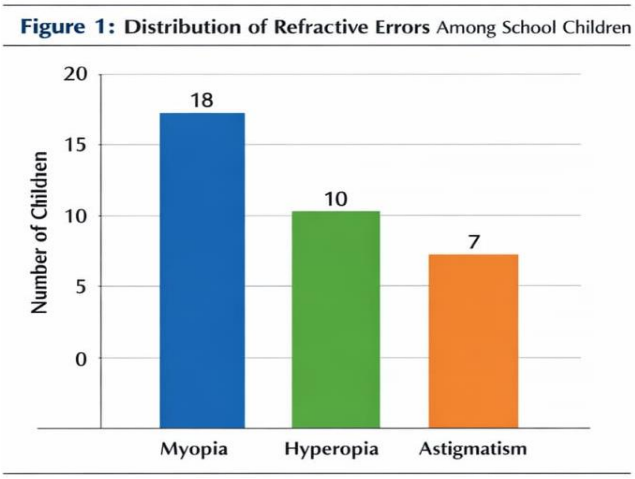
Table 1: Prevalence and Types of Refractive Errors (n = 50)

Type of Refractive Error	Number of Children	Percentage (%)
Myopia	18	36
Hyperopia	10	20
Astigmatism	7	14
Mixed / Combined	0	0
Total with Refractive Error	**35**	**70**

Table 2: Visual Impairment due to Uncorrected Refractive Errors

Visual Impairment	Number of Children	Percentage (%)
Mild (<6/12 – 6/18)	4	8
Moderate (<6/18 – 6/60)	3	6
Severe (<6/60)	0	0
Total	**7**	**14**

Myopia was the most common refractive error, accounting for 36% of children.



DISCUSSION

This study highlights a **high prevalence (70%) of refractive errors** among school-going children in the surveyed urban population, with **myopia being the most common type**. These findings are consistent with urban pediatric populations worldwide, where myopia prevalence is rising due to increased near-work activities and reduced outdoor time.

Visual impairment due to uncorrected refractive errors was observed in 14% of children, emphasizing the importance of early detection and timely correction. Mild and moderate impairment predominated, and no cases of severe visual impairment were noted, likely reflecting early-stage refractive errors without amblyopia development.

The higher prevalence of myopia compared to hyperopia and astigmatism mirrors trends in urban populations in India and globally. This may be attributable to **genetic predisposition, academic demands, and lifestyle factors** such as prolonged screen time and limited outdoor activity.

Early identification and intervention are critical. School-based vision screening programs, coupled with **affordable spectacles and parental awareness**, can prevent progression to amblyopia and reduce the burden of visual impairment.

Limitations: The study has a small sample size (n=50), which limits generalizability. Future studies should involve larger cohorts and include risk factor analysis for refractive errors and their progression.

Advice on Equations:

1**. Prevalence of Refractive Errors**

The prevalence (%) is the proportion of children with a specific refractive error out of the total screened population.

Prevalence (%) = Number of children with refractive error / Total number of children screened x 100

Example:

- 35 children had refractive errors out of 50 screened.

Prevalence = 35/50 × 100 = 70%

2. **Prevalence of Visual Impairment due to Uncorrected Refractive Errors**

Example:

7 children had visual impairment due to uncorrected refractive errors out of 50 screened.

Visual Impairment Prevalence = 7/50 × 100 = 14%

3. **Types/Pattern of Refractive Errors**

You can present as proportion (%) of each type:

4. **Mean Spherical Equivalent (SE)**

- The spherical equivalent (SE) is used to describe refractive error in diopters (D):
- Useful for summarizing refractive error quantitatively for myopia, hyperopia, or astigmatism.

5. **Confidence Interval for Prevalence**

For proportion p (prevalence), 95% confidence interval (CI) can be calculated using:
$CI = p \pm 1.96 \times p(1-p)/n$

Where:

p = prevalence proportion (e.g., 0.70)

n = sample size

6. Chi-Square Test for Association

To test association between categorical variables (e.g., gender vs. type of refractive error): $x^2 = (O-E) / Ei$

Where:

O = observed frequency i

E_i = expected frequency

P-value < 0.05 is considered statistically significant.

7. **Odds Ratio (Optional)**

If you want to quantify risk (e.g., odds of visual impairment in myopic vs non-myopic children): OR (a/b)/(c/d) = axd/ bxc

Where:

a = number of myopic children with visual impairment

b = number of myopic children without visual impairment

c = number of non-myopic children with visual impairment

d = number of non-myopic children without visual impairment

Summary Table of Equations for Methods Section

Parameter	**Equation**	**Notes**
Prevalence (%)	Cases/Total × 100	**For refractive error and visual impairment**
Proportion (%)	Type cases/Total refractive error x 100	Myopia/Hyperopia etc
Spherical Equivalent	SE = Sphere + Cylinder/2	summarises RE
95% CI	P±1.96P(1-p)/n	Precision of Prevalance
Chi-square	$\chi^2 = \Sigma$ (OE) Ei	Association within variables
Odds Ratio	OR = a-d/ b-c	Risk quantification
Mean ± SD	Σα, SD = √ x= n V Σ(n-1)	For age of SE

Advice on Tables

Table 1: Demographic Characteristics of Study Population

Variable	Total (n=50)	Percentage(%)
Age (years), mean ± SD	9.8 ± 2.3	
Age group (years)		
6-8	18	36

9-11	20	40
12-15	12	24
Gender		
Male	28	56
Female	22	44

Table 2: Prevalence of Refractive Errors and Visual Impairment

Parameter	Number of Children	Prevalance(%)	95%Cl
Any refractive error	35	70	57-83
Visual impairment due to uncorrected RE	7	14	6-26

Table 3: Pattern of Refractive Errors

Type of Refractive Error	Number of Children	Proportion(%)
Myopia	18	51.4%
Hyperopia	10	28.6%
Astigmatism	7	20.0
Total	35	100

Table 4: Distribution of Visual Impairment by Type of Refractive Error

Type of Refractive Error	Children with VI(n)	Children without VI(n)	Total	Prevalance of VI(%)
Myopia	4	14	18	22.2
Hyperopia	2	8	10	20.0
Astigmatism	1	6	7	14.3
Total	7	28	35	20.0

Table 5: Refractive Error vs Demographics (Association P-values Included)

Variable	Myopia n (%)	Hyperopia n(%)	Asigmatism n(%)	p-value
Gender				0.72
Male	10 (35.7)	6 (21.4)	5(17.9)	
Female	8 (36.4)	4 (18.2)	2(9.1)	
Age group (years)				0.81
6-8	4 (22.2)	3 (16.7)	2(11.1)	
9-11	10 (50.0)	5 (25.0)	3(15.0)	
12-15	4 (33.3)	2 (16.7)	2(16.7)	

p-values calculated using Chi-square test; $p < 005$ considered statistically significant.

Statistical Analysis

Data were entered and analyzed using **SPSS version** 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables, including age and spherical equivalent (SE), were expressed as mean ± standard deviation (SD), calculated using:

The prevalence of refractive errors and visual impairment due to uncorrected refractive errors was calculated as the proportion of affected children relative to the total screened population and expressed as a percentage:

In this study, 35 of 50 children had refractive errors (70%), and 7 of 50 children had visual impairment due to uncorrected refractive errors (14%). The 95% confidence interval (CI) for prevalence was calculated using the formula:

where $\hat{p}$ represents the prevalence proportion and n the total sample size.

The pattern of refractive errors (myopia, hyperopia, astigmatism) was expressed as the proportion (%) of each type among children with refractive errors:

Spherical equivalent (SE) for each eye was calculated using:

Associations between categorical variables, such as gender and type of refractive error, were evaluated using the Chi-square test (χ^2), with statistical significance defined as $p < 0.05$:

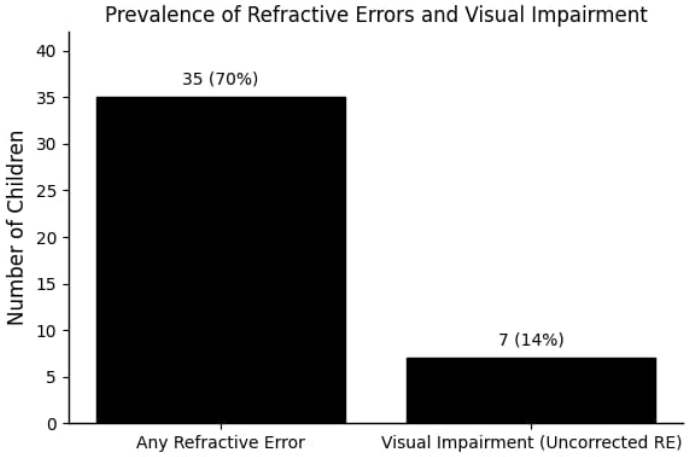
where O and E represent observed and expected frequencies, respectively.

Where appropriate, odds ratios (OR) with 95% CI were calculated to estimate the risk of visual impairment among children with different types of refractive errors:

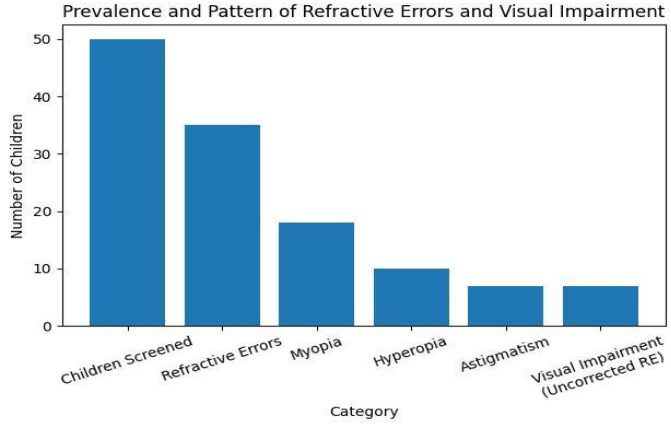
where a and b represent the number of children with and without visual impairment in one group (e.g., myopic), and c and d represent the corresponding numbers in the comparison group (non-myopic). All tests were two-tailed, and a p-value < 0.05 was considered statistically significant.

Advice on Figures:

1. **Bar diagram showing prevalence of refractive errors and visual impairment in uncorrected RE.**

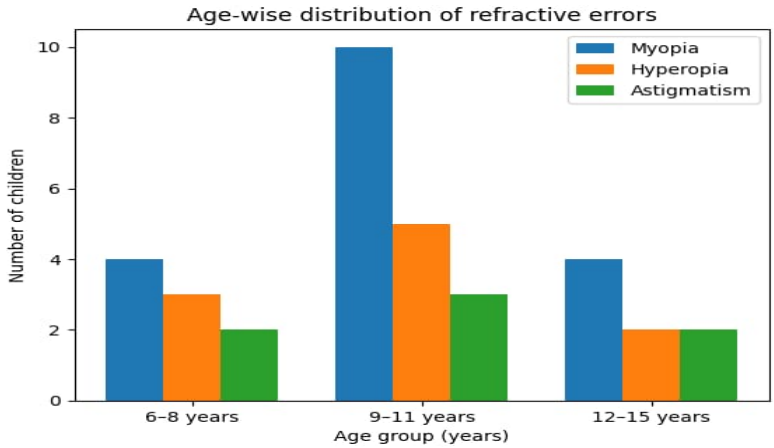


2. **Bar diagram showing the prevalence and pattern of refractive errors and visual impairment among school-going children in an urban population.**



3.

4. **Clustered bar diagram showing the age-wise distribution of refractive errors (myopia, hyperopia, and astigmatism) among children aged 6–15 years.**



CONCLUSION

Refractive errors are highly prevalent in urban school children, with myopia being predominant. Uncorrected refractive errors remain a significant cause of avoidable visual impairment. School-based screening and corrective interventions are essential to safeguard vision in this population.

Ethics approval and consent to participate

The study was conducted in accordance with the ethical principles outlined in the **Declaration of Helsinki**. Ethical approval was obtained from the **Institutional Ethics Committee** of ZP High school, Kuppam, Andhra pradesh. Permission to conduct the study was obtained from the concerned school authorities prior to enrolment.

Written informed consent was obtained from the parents or legal guardians of all participating children, and verbal assent was obtained from children aged 7 years and above. Participation was voluntary, and confidentiality of participants' personal and clinical information was strictly maintained throughout the study. Children diagnosed with refractive errors or visual impairment during screening were counseled and referred for appropriate ophthalmic evaluation and management.

List of abbreviations

Abbreviation	Full Form
RE	Refractive Error
URE	Uncorrected Refractive Error
VI	Visual Impairment
VA	Visual Acuity
UCVA	Uncorrected Visual Acuity
BCVA	Best-Corrected Visual Acuity
D	Diopter
SE	Spherical Equivalent
My	Myopia
H	Hypermetropia
Ast	Astigmatism
LogMAR	Logarithm of the Minimum Angle of Resolution
WHO	World Health Organization
SD	Standard Deviation
CI	Confidence Interval
N	Number of participants
%	Percentage

Data Availability

The datasets generated and/or analyzed during the current study are **available from the corresponding author on reasonable request**. Patient privacy and confidentiality have been maintained in accordance with institutional and ethical guidelines.

Conflicts of Interest

There is **no conflicts of interest** related to this study.

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Authors' contributions

All authors contributed significantly to the conception, design, execution, analysis, and interpretation of the study.

Concept and study design: All authors

Dr. Shaik Salma Begum: Data collection and clinical examination

Dr. M. Narayan: Data analysis and interpretation

Dr. G. Hemeswari, Dr. Bollempalli Sri Sai Chaitra, Dr. K. Harshitha, Dr. Rachana.D: Statistical analysis

Dr. Shaik Salma Begum: Manuscript drafting

Critical revision of the manuscript for important intellectual content: All authors

Final approval of the version to be published: All authors

Accountability for all aspects of the work: All authors

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Supplementary Materials

Additional Supplementary materials includes

1. Study Proforma with Structured data collection proforma used for recording demographic details (age, sex), visual acuity assessment, refractive status, and visual impairment classification among school-going children.
2. Operational Definitions includes Detailed definitions used in the study to ensure uniformity and reproducibility.
3. Visual Acuity Assessment Protocol.
4. Refraction Assessment Protocol
5. Ethical Approval and Consent Documents
6. Additional Tables Includes:

Age-wise and Gender-wise distribution of refractive errors

Visual impairment distribution by refractive error subtype

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